iPulsaret

microsound granular synthesis for iPad

user manual v.1.1

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www.densitygs.com

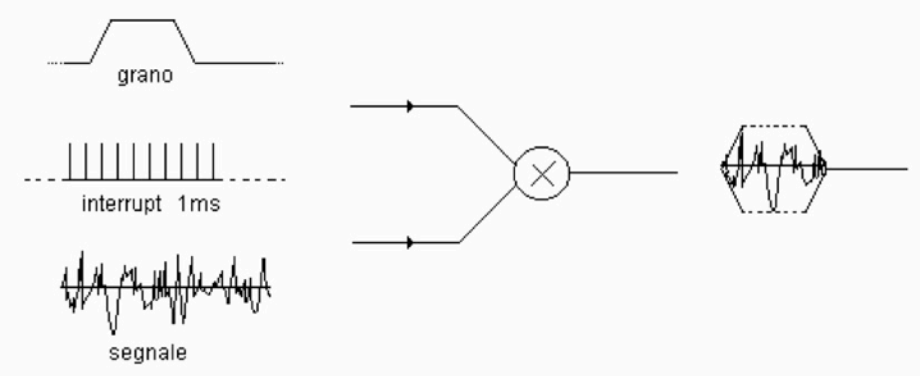
Control and shape grains, anytime, anywhere with iPulsaret for iPad.

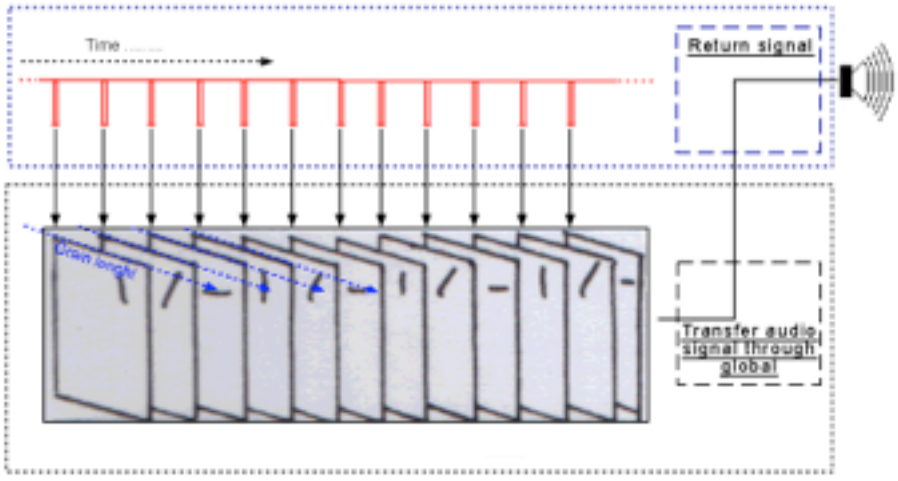
Requirements

Compatible with iPad. Requires iOs 6 or later.

About the project

First **Density** (standalone windows 2001) release was developed in Csound language and based on Eugenio Giordani 's GSC4 (Granular Synthesis for Csound). GSC4 implements the Barry Truax model.
iPulsaret can generate thousands of grains dynamically, rather than a fixed number of "voices" (oscillators or granular streams). So, the maximum overlapping limit depends by the CPU power.
Below an easy granulation model.





iPulsaret for iPad brings all the powerful **Density/Pulsaret** (Mac/Win standalone) Granular Synthesis tools to the world's most popular tablet.
iPulsaret is inspired to **Curtis Roads' book "Microsound"**. The Csound DSP (Csound API for iOs) code, employes *partikkel* opcode, capable of all time-domain varieties of granular synthesis described in this book.
Csound for iOS by **Victor Lazzarini** and **Steven Yi** www.csounds.com
partikkel opcode by **Thom Johansen**, **Torgeir Strand Henriksen** and **Øyvind Brandtsegg**

iPulsaret can use single-cycle or complex (e.g. sampled sound) waveforms as source waveforms for grains. Each grain consists of a mix of 4 source waveforms. Individual tuning of the base frequency, also frequency modulation inside each grain and Trainlet/Grainlet/Pulsaret synthesis is available.

You can find more details about granular synthesis on the wiki: http://en.wikipedia.org/wiki/Granular_synthesis
You can download Mac/Win standalone demo here: www.densitygs.com

UI-User Interface

RED: Deterministic Granulator Parameters;
ORANGE: Random Granulator Parameters;
PURPLE: FX Chain: Echo, Ring Modulation, Lowpass res, High Shelving, Reverb and Dynamic Compressor;
BLUE: The Keyboard provides note on/off, key velocity and Y Aftertouch. Y Aftertouch can be associated to one of the Granulator or FX parameters.

Granular Parameters

In this section we'll examine the Granular Synthesis parameters. Please refer to web for more explanations about granular synthesis. http://www.dspguide.com

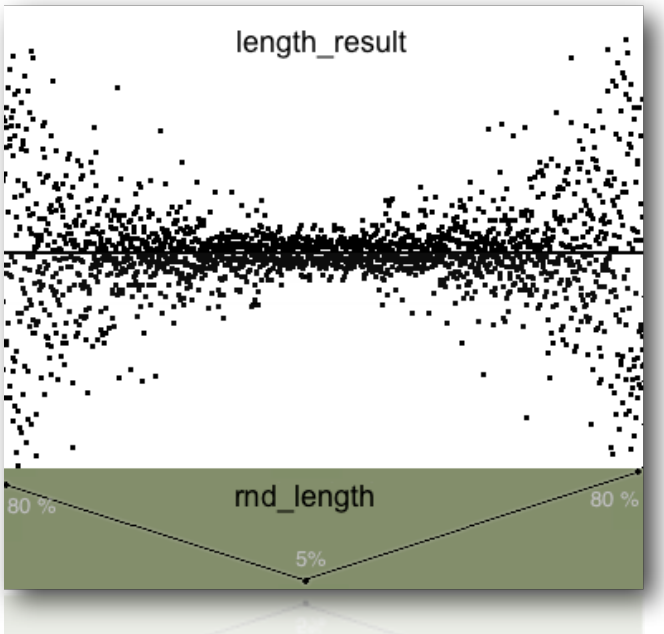
Double tapping on sliders you can switch between default/last value and the two buttons (most left and most right of slider) change fine increment/decrement. A long pressure on them involve a recursive increment or decrement.

iPulsaret granulator engine is updated every *grain*, the frequency of grains scattering depends from **Grains Density** parameter expressed in Hz (grains for seconds).
Each granulator parameters is calculated by summing a couple **deterministic-random**. The result is used for the granulation, the update frequency depends by grains scheduling i.e. Grain Density in Hz.
In the example we have the **Grains Length** (deterministic value) balanced over own **Random Length**, thus, in the time (X axis) the pitch mask, changes from 80% to 5% and finally 80%.

length_result = length + (birnd(rnd_length * length/2))

Where **birand** is bipolar random generator. The random range is expressed in %, therefore 0 % it means only deterministic value; 100 % it means the **length_result** can vary in all the range:

length_result = length ± length/2



In the example **rnd_length** (green frame) starts from 80% to arrive at 5 % in the middle then go up again.
With an high **rnd_length** every grain can have an high random pitch deviation range. Carrying **rnd_length** toward lowest values, the random pitch mask is reduced until 0 % which means no random pitch grain scattering.

Grains Amplitude *(%)* = grains output amplitude, multiplied by per grain amplitude;
Stereo Width *(%)* = grains spread, random distributions on the stereo field;
Grains Density *(Hz)* = grain for seconds in Hz or gps i.e. grains for second;
Random Density *(%)* = random range deviation, in % of Grains Density;
Grains Length *(Ms)* = grain duration in milliseconds;

Random Length *(%)* = random range deviation, in % of Grains length;
Random Grain Masking *(%)* = random masking (muting) of individual grains. Range 0 to 1, where a value of 0 will give no masking (all grains are played), and a value of 1 will mute all grains.
Random Frequency *(Semitones)* = random range deviation, 0: no frequency deviation, 12: one octave range deviation i.e. one octave == 12 semitones;
Grain Frequency Modulation *(Hz)* = FM modulator signal expressed in Hz,
Grain Index Frequency Modulation *(%)* = FM Index of modulation, A value of zero, it mean no FM modulation.

Tools Bar

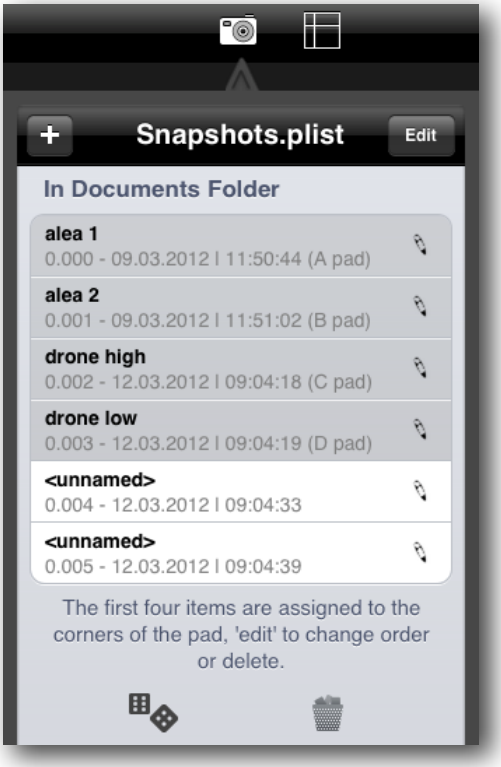
From left to right we have:
DSP On/Off; **Play/Stop DSP** (play icon); **Snapshots** (camera); **Snapshots Pad**; **Grain Wave Source** (sinusoid); **Grain Envelope**; **Grain Glisson Sweep**; **Grainlet**; **Restore Defaults** (safe);
On the most right, we have **Settings** and **About** (home icon).

Play/Stop DSP

iPulsaret DSP (Digital Signal Processing) is triggered by **On/Off** toolbar icon (default is on). When is off you will not able to interact with UI parameters, you need switch on to restore normal condition.
iPulsaret supports mix audio with other applications, you can disable DSP in order to save battery and CPU consuming.

N.B. iPulsaret can play also when app is in background, so you can mix audio from two or more apps

Snapshots


Snapshots.plist
Edit
In Documents Folder
alea 1
0.000 - 09.03.2012 I 11:50:44 (A pad)
alea 2
0.001 - 09.03.2012 I 11:51:02 (B pad)
drone high
0.002 - 12.03.2012 I 09:04:18 (C pad)
drone low
0.003 - 12.03.2012 I 09:04:19 (D pad)
<unnamed>
0.004 - 12.03.2012 I 09:04:33
<unnamed>
0.005 - 12.03.2012 I 09:04:39
The first four items are assigned to the corners of the pad, 'edit' to change order or delete.

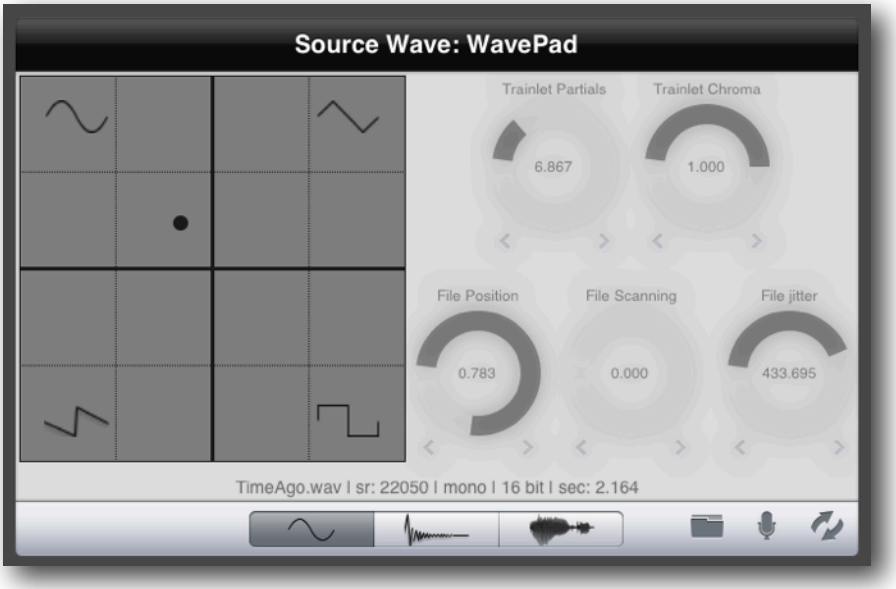
A *snapshot* is a photo of all parameters Granulator and FX values.
When you've found an interesting "sound" you can take a snapshot touching on the *plus* icon in the Snapshot popover. A new item will be added to Snapshots.plist file. As File Manager you can move delete or rename items.
Snapshots.plist file is placed on the Documents folder, you can copy file by iTunes (see Add files to iPulsaret through iTunes).
You can recall a snapshot simply selecting item from the list or touch *dice* icon to select randomly.
All parameters values will be restored at current snapshot, immediately.
Trash icon allow you to delete all snapshots items in the Snapshot.plist file.
"Edit" (top right) allow you to delete or move items on the list. The first four snapshots on the list they are employed for "Snapshots Pad" (see later) so, you can change the order of snapshots in order to assign snapshots to four Pad edges.

Snapshots Pad

The Snapshots Pad goal is to obtain intermediate values between four snapshots (corners). You can assign corners snapshots from the Snapshots list (see above).
Snapshots Pad performs a snapshots interpolations, displays nodes in a 2-dimensional space, and calculates the distance from a point. The distance factor determine the weight between snapshots interpolation. Thus you can modify hundreds of parameters with a single touch motion, according to a structure configured by the user. This control method is also called *Hyper Vectorial Synthesis.*
"Snapshots Pad" can be showed fullscreen for more fine controls (left bottom icon).

See Density/Pulsaret Standalone DSP at: www.densitygs.com

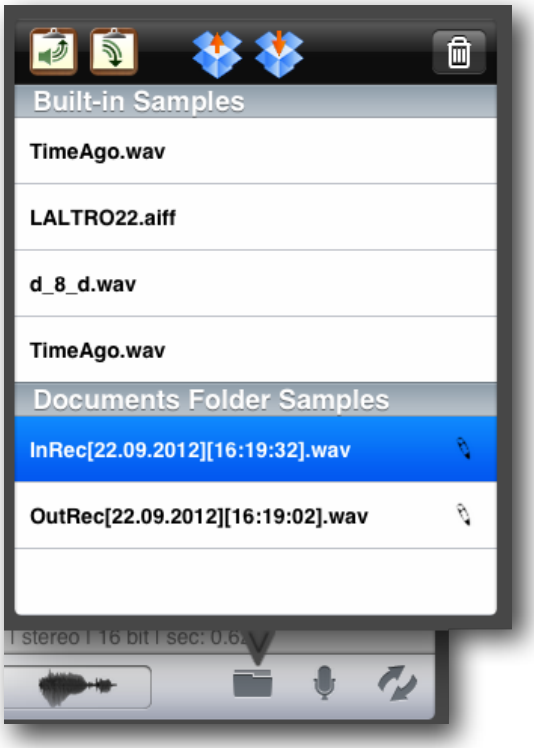
Grain Wave Source



iPulsaret can use single-cycle or complex (e.g. sampled sound) waveforms as source waveforms for grains.
You can switch between three operation modes: **WavePad**, **Trainlet** and **Sampled Sound**.
Each grain consists of a mix of 4 source waveforms, selected by **WavePad**.
Entering in **Trainlet** mode, you will see own Knobs enabled. Thus you can change Trainlet parameters.
Trainlet Partials set the number of cosine partials harmonically related.
Trainlet Chroma: a value of 1 give equal amplitude to each partial, higher values will reduce the amplitude of lower partials while strengthening the amplitude of the higher partials.
In **Sampled Sound** mode, you can manipulate **Time Position**, **Time Scanning** and **Time jittering**.
Time Position sets manually the start reading position in the file.
Time Scanning *(Ratio)* = playback scanning ratio: value 1: original time, value 0.5: half-tempo (time stretching), 2: twice-tempo (time compressing); 0: freezes playback at the current location; negative values rate: backwards play;
Time Jittering *(Ms)* = randomly moves the time-pointer around the current value (scanning or scrubbing), the value is expressed in milliseconds;
You can select a new sound sample through the file manager (see below), only ***wav*** or ***aif (aiff)*** are supported, you can also load a ***raw*** file, for glitch generation.

N.B. when you sets scanning to zero (freeze see below) the current File Time position will be taken from absolute value (File Time Position), thus you can take a snapshots with correct offset.

File Manager



You can load from **built-in** audio samples and read/write **Documents folder**.
Copy and Paste audio from/to **Sonoma Wire** MAPI-ACP (see later).

Add files to iPulsaret through iTunes

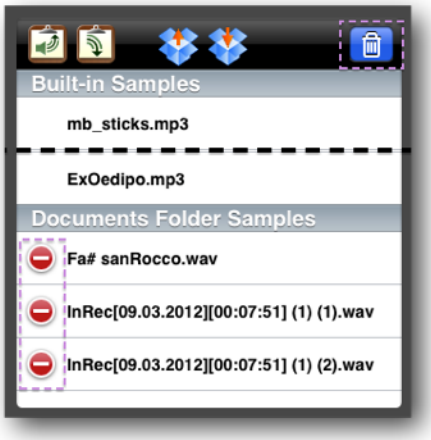
- Launch iTunes.
- Connect your iPad to your computer with the USB dock cable.
- Select your iPad from the Devices list in the iTunes Library column, then click the Apps tab.
- Now scroll to the bottom of the iTunes window to see the File Sharing area.
- Apps on your iPad that support file transfers appear in the Apps list. Selecting iPulsaret icon tells iTunes which app you want to transfer files for.
- Click Add at the bottom of the Documents pane to find the documents you want to copy to your iPad.
- Now click Sync to copy the documents to your iPad.

You can also select files in the Documents list to copy them to your computer. This is a fairly easy way to make sure the files you create on your iPad find their way to your desktop or laptop machine.

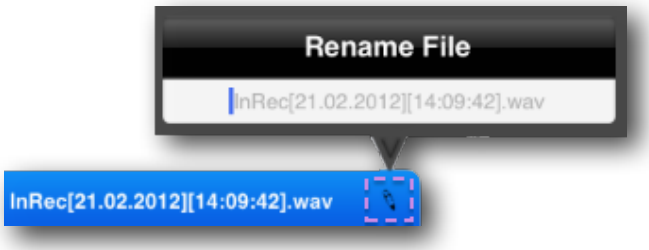
In the above example we have three files in **Documents folder**, in the example all files are created by iPulsaret. Observing the prefix you will see the file origin followed by date and time:

AudioPaste[*date***] [***time***]**
InRec[*date***] [***time***]**
OutRec [*date***] [***time***]**

Every time you grab audio from Mic (see later) you will create a new file called **InRec[...][...]**, in the same way when you record the output signal (Master) you will create **OutRec[...][...]** and at the end you will create an **AudioPaste[...][...]** (see later) prefixed file pasting from Sonoma Wire.
You can edit **File manager** contents and delete files, as you see you cannot delete built-in sounds.
n.b. It's a destructive action.
n.b. File manager can read only audio files supported, if you have unsupported files in the Documents folder, you won't able to see on the file manager popover.



You can also rename files in Documents Folder, just touch pencil icon on the right of each file.



What Is Audiocopy/Audiopaste?

www.sonomawireworks.com

Taking the Copy/Paste features in the Apple iPhone software to a new level, Sonoma Wire Works has developed AudioCopy and AudioPaste functionality for the iPhone/iPod touch/iPad.

- Record audio using any AudioCopy compatible app below.
- Open the AudioCopy Song Tool within the compatible app.
- Preview and Copy Audio. The audio data captured includes tempo info, file format info, the name of the app copied from, duration, and more.
- Select an app to Paste to from the "Compatible Apps List".
  - If owned, the app will launch, and pasting can be done using that app's AudioPaste Tool.
  - If not owned, you'll be taken to the store to purchase first, then you'll be able to paste.
- Clipboard will keep your data until you paste it into your purchased app, or until you copy other audio.
- AudioPaste Clipboard will display the info captured, and allow you to choose how many loops to paste.
- Some apps that support AudioPaste, including FourTrack, allow you to paste within a particular position in your song.
- **NEW:** Apps that support AudioCopy 1.1 now include a pasteboard history of up to 12 items with audio previews!
- **NEW:** Apps that support AudioCopy 1.1 now include support for Apple's General Pasteboard (which means BeatMaker integration).

Sonoma AudioCopy is used for copying a 44.1 kHz - 16 bit PCM mono or stereo audio files, so, if you select a different kind, AudioCopy icon will be disabled until you select a valid format.

How To Video: AudioCopy/Paste

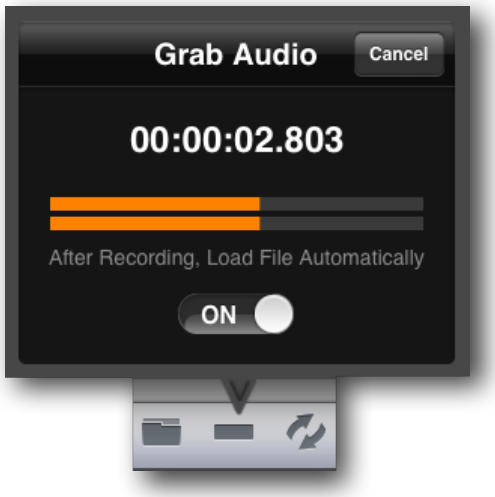
For more details see:
www.sonomawireworks.com

Dropbox

Upload and download files from Dropbox, you need a Dropbox account.
For more details see:
www.dropbox.com

If you are not logged, the first time you upload or download, will ask you a user and password.
You can log out from dropbox and/or change accounts through iPulsaret Settings, see later for explanations.

Grab audio from mic



Touch on mic icon to Start grab audio immediately, (the icon became minus) then touch again to stop recording. If you stop before than 250 msecs, a warning message will show you, no audio will be saved. Every time you grab audio, a new file will be created, named **InRec[...][…]** where **InRec** is the prefix followed by date and time, see File Manager for further explanations. You can abort grab audio pushing on cancel button and switch on/off on “After Recording, Load File Automatically”. this is saved on the iPulsaret Settings, see later for explanations.
n.b. Depending from device input audio, you will see one or two V-Meters for the Left/Right channels, it means you will record a mono or stereo file in **wav** format 16 bit 44.1 kHz.

Time Freeze

Time Freeze (*refresh icon)* is a shortcut for the **Time Scanning** parameter (see Sampled Sound above), **Time Freeze** switch between the value 0 (frozen) and the last value.

N.B. when you sets scanning to zero (freeze see below) the current File Time position will be taken from absolute value (File Time Position), thus you can take a snapshots with correct offset.

Grain Envelope

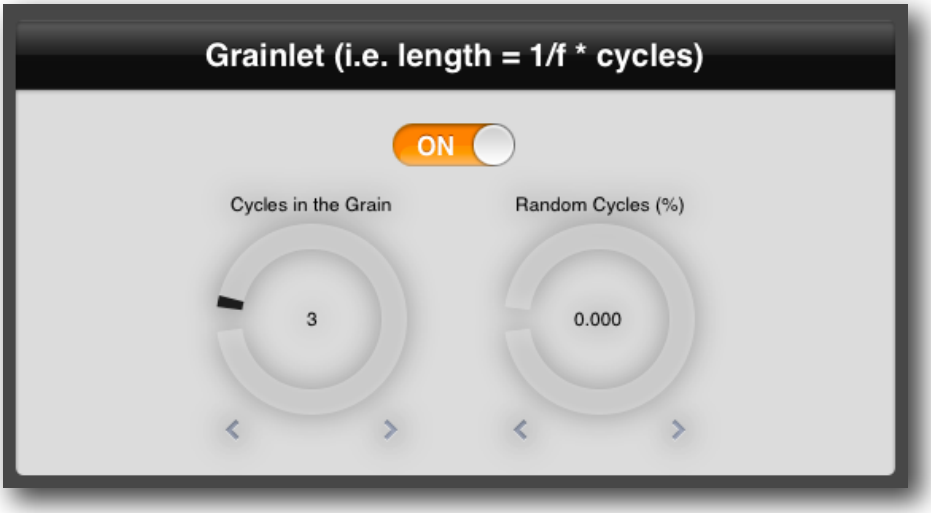
Grains envelope is used for smoothing the grain amplitude, three shapes for the Attack/Decay.

Envelope Deformation increase/decrease proportionally Attack/Dekay durations. A value of 1 it mean 50 % (grain length/2) for the Attack and 50 % (grain length/2) for Decay. A value of zero produce a rectangular Envelope. Grain Envelope does not change Grains Length.

Grain Glisson Sweep

Glisson Modes sets the glissando direction Up, Down or Random inside of every grain.
Glisson Amount sets the sweep amount in Semitones according to three operation modes.
Glisson Shape, controls the curvature of the transposition sweep. Range 0 to 1. Low values will hold the transposition at the start value longer and then drop to the end value quickly, high values will drop to the end value quickly. A value of 0.5 will give a linear sweep. A value of exactly 0 will bypass sweep and only use the start frequency, while a value of exactly 1 will bypass sweep and only use the end frequency. The sweep generator might be slightly inaccurate in hitting the end frequency when using a steep curve and very long grains.

Grainlet



A **Grainlet/Pulsaret** consists in a brief burst of energy. The grain duration contains one or more cycles (integer numbers), varying the grain frequency (keyboard note) you change internal frequency of grain i.e. “duty cycle”, while density parameter is independent. Enabling Grainlet the *Grain Length* will became depending from *Grain Frequency*.
Also you can select the numbers of Cycles for Grains introducing a Random deviation, according to Deterministic/Ramdomic logic, explained above.
e.g.
Cycles in the Grain = 2;
Grain Frequency = 100 Hz;
Grain Length = 1/Grain Frequency = 0.01 * Cycles in the Grain = 0.02 Sec (20 Ms)

N.B. When Grainlet is enabled, Grain Length and Random Grain Length in Main View will temporally disabled.

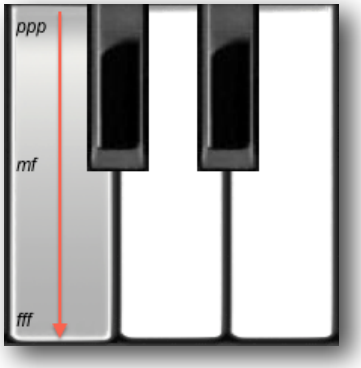
Restore defaults

All **iPulsaret** sliders and knobs, recognize double tap gesture, double tapping on the slider or knob to reset at default value and double tap again to jump at last position value, so you can easy switch between default/ last values.

Naturally you can reset all parameters at defaults values by touching the toolbar icon (safe), a message warning will be displayed.

Keyboard

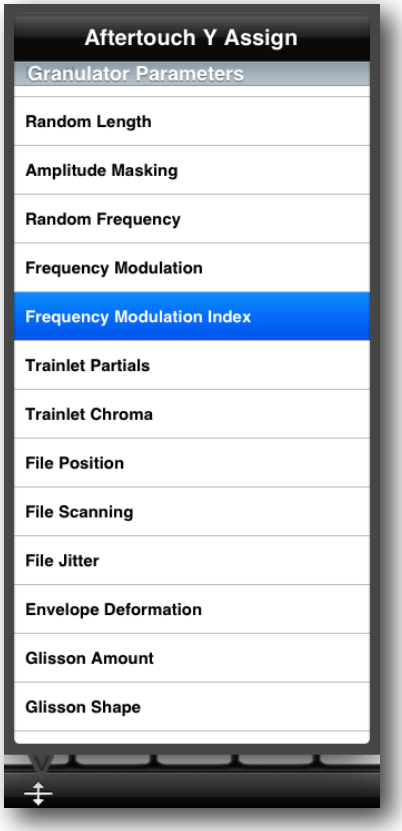
Playing keys from top to bottom, you can change the amplitude of each note i.e. key velocity (0 ÷ 127). Idem for the black keys, naturally. You could think the keyboard like an audio spectro-tool, on a temperated grid. Thus you can create complex sounds by summing notes with own couple frequency/amplitude weights. If Keyboard is locked (see below), Snapshots will save/restore state.



The bottom bar show four items, (from left to right) we have **Aftertouch Y scrub**, **Keys Lock**, **ADSR Envelope** for the note and **Midi Panic.**

Locking the Keys (center icon) it mean every note behave like a Toggle. Now the played note is kept hold down (note on) until you touch again (note off). If Keyboard is locked (see below), Snapshots will save/restore state.

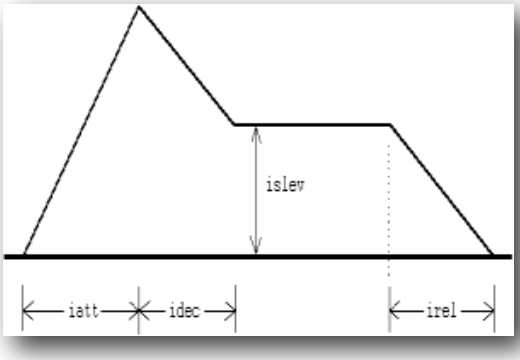
On the left we have **Aftertouch Y** for assign an iPulsaret parameter to aftertouch scrub Y.



Thus, after played a note you can scrub in vertical axis (Y) by controlling one of the Granulator/Effects parameter. Therefore you need make parameter association trough the Aftertouch Y menu.

See iPulsaret Settings in order to change step Resolution of Aftertouch Y axis.

The two last items (on the right): **ADSR Envelope** and **Midi Panic.**
ADSR, calculates the classical ADSR envelope using linear segments. The length of the sustain is calculated from the length of the note.



iatt - duration of attack phase in seconds (Attack)
idec - duration of decay in seconds (Decay)
islev - level for sustain phase in % (Sustain)
irel - duration of release phase in seconds (Release)

Control release time after receiving a Keyboard note Up or MIDI note off event. If zero or more, the given value will be used for release time.

The last **Midi Panic** button, sends a general Message "All Notes Off" at the DSP and Keyboard.

Effects Chain

From left to right we have: *Stereo Echo, Ring Modulation,* Lowpass res (Moog diode ladder emulation) *Filter, High Shelving Filter, Reverb (*8 delay line stereo FDN reverb, based on work by Sean Costello)*, Dynamic Compressor/expander* All FX parameters are *Knobs,* as the *Sliders,* by double tap on them you can switch between default/last value and the two buttons (most left and most right of slider) change fine *increment/ decrement*. A long pressure on them involve a recursive increment or decrement.

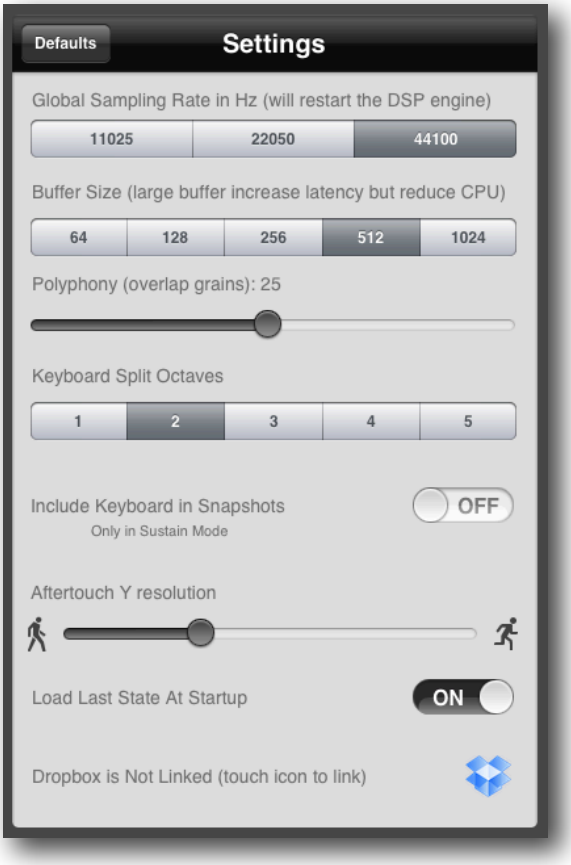
The first effect of the chain (leftmost) is **Stereo Echo**, it receive signal from **Granulator Engine**. If Stereo Echo is enabled the processed signal is passed to the next effect in the chain (Ring Modulation) or bypassed if disabled.
You will see enabled effects by toolbar icons (orange colored) you can switch between popovers effects while play on the Keyboard.

Below example show High Shelving Filter popover opened. The signal flow in the example is:
Granulator >> RM >> HI Shelf >> Comp >> Output

For more explanations about the audio digital signal processing, please refer to the web:
http://www.dspguide.com

The Record icon (*circle*) captures the Output stereo signal after the FX chain and creates an **OutRec[...][...]** file in the Documents Folder (see File Manager).
V-Meters shows the iPulsaret stereo output level and the rightmost icon (*loudspeaker*) it's a software shortcut for the hardware amplitude gain.

Settings



You can set the audio **Sampling Rate**, for full-range audio, the recommended sampling rate is 44.1 kHz. Using a lower rate will reduce the number of samples that iPulsaret has to calculate, thus lightening your iPad's burden, but it will also reduce the frequency range. If your device is struggling at 44.1 kHz, you should try a lower rate.

Buffer Size is the number of samples in a control period, a great value, increase latency but avoid the CPU overhead and vice-versa.

Polyphony change the overall grains overlapping (maximum numbers of simultaneous grains). Default is 25 the max value allowed is 50, actually the granulator engine have not a limits, but 50 grains is a good compromise. N.B. Grains Overlapping overall is referred to all note polyphony, therefore if you have three keys down on the keyboard, maximum overlapping will be 25/3.

Keyboard Split (Octaves) sets the number of keys visible in the main view**.**

Include Keyboard in Snapshots enable/disable Snapshots capture for Keys Down. It work only if Keyboard is in Locked mode (see above)

Aftertouch Y resolution sets the step relative step increment for the keyboard Y aftertouch Y axis.

Restore last Setup at Startup, when you start application restore all Granulator and Fx Parameters.

Dropbox sign in/out, you can login or logout from Dropbox accounts here, see FileManager section.

MIDI CONTROL CHANGE ASSIGNMENTS

(Channels Omni or 1 ÷ 16)

Granular Parameters

Grain Amplitude	CONTROL CHANGE **20**
Stereo Width	CONTROL CHANGE **21**
Grain Density	CONTROL CHANGE **22**
Random Density	CONTROL CHANGE **23**
Grain Length	CONTROL CHANGE **24**
Random Length	CONTROL CHANGE **25**
Grain Amplitude Masking	CONTROL CHANGE **26**
Random Frequency	CONTROL CHANGE **27**
Grain Frequency Modulation	CONTROL CHANGE **28**
Grain Index Frequency Modulation	CONTROL CHANGE **29**

Grain Sources

Grain Wave Source	CONTROL CHANGE **30**
WavePad X	CONTROL CHANGE **31**
WavePad Y	CONTROL CHANGE **35**
Trainlet Partials	CONTROL CHANGE **41**
Trainlet Chroma	CONTROL CHANGE **46**
File Position	CONTROL CHANGE **47**
File Scanning	CONTROL CHANGE **52**
File Jitter	CONTROL CHANGE **53**

Grain Envelope

Envelope Attack Shape	CONTROL CHANGE **54**
Envelope Deformation	CONTROL CHANGE **55**
Envelope Decay Shape	CONTROL CHANGE **56**

Grain Glisson

Glisson Sweep Mode	CONTROL CHANGE **57**
Glisson Amount	CONTROL CHANGE **58**
Glisson Shape	CONTROL CHANGE **59**
Grainlet on/off	CONTROL CHANGE **60**
Grainlet Cycles in the Grain	CONTROL CHANGE **61**
Grainlet Random Cycles	CONTROL CHANGE **62**

FX Parameters

Echo on/off	CONTROL CHANGE **63**
Echo Left Delay	CONTROL CHANGE **85**
Echo Left Gain	CONTROL CHANGE **86**
Echo Right Delay	CONTROL CHANGE **87**
Echo Right Gain	CONTROL CHANGE **88**
RM on/off	CONTROL CHANGE **89**
RM Frequency	CONTROL CHANGE **90**
RM Dry/Wet	CONTROL CHANGE **102**
Lowpass on/off	CONTROL CHANGE **103**
Lowpass Res Cutoff	CONTROL CHANGE **104**
Lowpass Res Q	CONTROL CHANGE **105**
High Shelving on/off	CONTROL CHANGE **106**
High Shelving Cutoff	CONTROL CHANGE **107**
High Shelving Amount	CONTROL CHANGE **108**
High Shelving Q	CONTROL CHANGE **109**
Reverb FDN on/off	CONTROL CHANGE **110**

Reverb FDN Feedback	CONTROL CHANGE **111**
Reverb FDN Low Cutoff	CONTROL CHANGE **112**
Reverb FDN Dry/Wet	CONTROL CHANGE **113**
Dynamic on/off	CONTROL CHANGE **114**
Dynamic Ratio	CONTROL CHANGE **115**

ADSR Envelope

Attack	CONTROL CHANGE **116**
Decay	CONTROL CHANGE **117**
Sustain	CONTROL CHANGE **118**
Release	CONTROL CHANGE **119**

Release History

iPulsaret 1.0 *(october 2012)*
- iOs 6 deployments target
- 16 Polyphony Voices
- ADSR Note Envelope
- Aftertouch Y scrubbing
- Snapshots Presets and Snapshots Morphing Pad
- Documents folder sharing via iTunes
- Sonoma Audio Copy and Paste
- Dropbox Supports
- Sound File and Snapshots rename
- Granulation Wave source: Prototypes WavePad, Trainlet and Sampled Sound
- Grain Envelope Deformation with three shapes
- Glisson sweep
- Grainlet linkage
- FX chain: Echo, Ring Modulation, Lowres and High Shelf filters, Reverb and Dynamic Compressor
- Record audio directly with iPad mic
- Auto load audio after recorded (on/off) in Grab Audio
- Capture Master Audio Output
- Run Audio in Background
- Sliders and Knobs double tap switch to Default/Last values
- Sliders and Knobs Fine step increment/decrement
- Settings: AfterTouch Y and
- Settings: Load last UI state
- Settings: Polyphony Grains Overlapping Controls
- Quick Help embedded
- etc.

iPulsaret 1.0.3 *(november 2012)*
- iOs 5.1 support
- MIDI In for keyboard (with Pitch Bend)
- AudioCopy fix issue
- Some UI improvements (FileManager and Dropbox)
- AfterTouch Y (file Scanning) bug fixed
- Audio routing improvement

iPulsaret 1.1 *(december 2012)*
- Universal app (iPad, iPhone and iPod Touch)
- MIDI channel select (omni or 1÷16)
- MIDI Input Control Change (for all Parameters)
- Keyboard Pitch Bend UI
- Some bugs fixed

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